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Example **DISCUSSION** of **Treatment protocols** for client Jane Starbright

To affect the greatest possible good for the client in regards to optimal health and nutrient status, an approach that methodically works through correcting and supporting the following biological areas has developed -

- Digestive function
- Diet and nutrient status
- EFA balance
- Antioxidant capacity
- Bowel dysbiosis
- Specific disease therapeutics
- Liver/Cellular detoxification problems
- Hormone synthesis and balance
- Neurotransmitter synthesis and balance

This thorough systemic approach is used both in the assessment and the subsequent treatment. Following on from the discussions of client Jane Starbright in the assessment, the example below highlights the Nutrition Medicine approach to Treatment

Briefly

To effectively deal with **URTI or LRTI** it is paramount to remove exposure to chemicals and if possible inhalent allergens and particularly food allergens and food ingredients causing sensitivities, as outlined in the above discussion. Go through the **Diet** with a fine toothed comb. Minimal exposure time should be organised to inhalent allergens and other irritants so that concurrent nutrition therapy can **optimise nutrition status**, metabolic function and detoxification capacity. A diligent search for food sensitivities often reveals **frequently eaten foods**.

Check seasonal and perenial pollen/grass exposure in clients area – through CSIRO, land care, etc – test for reaction via SPT and/or Rast IgE to these identified allergens – minimise exposure at known peak times - identify any cross reactive foods within the identified windborne allergen family and perform elimination/challenge tests to these foods. This is hard

work and not without challenges and would require diligence and persistence but the payoff would be an improved quality of life and decreased progression of inflammatory based lower lung disease (bronchiectasis).

From a nutritional perspective it is critical to identify any possible allergy promoting foods and while some of these foods may only initiate a low level IgE response, the cumulative and cross reactive effects between foods and wind born allergens can produce clinical symptoms of respiratory disease. (prawns promote an asthma response in this client). Patients with inhalent allergy frequently exhibit symptoms of Irritable bowel Syndrome (**need to investigate this further in this client**) and migraine – indicative of food reactivity.

Importantly **“sensitivity to gluten containing grains and milk products commonly underlies apparent apparent inhalent allergy reactions and avoidance of these foods often reduces or eliminates the response to inhalent allergens.”** *ref: Course 6 notes* .

Foods not coming up as positive in an IgE based screening may in fact come up as positive in an IgG4 test and although controversial, some symptom relief has been reported from eliminating foods from the diet identified by the IgG4 test. Thus recommend an [Allergix IgG4 screen](#) (from Metamatrix) to 90 common foods in addition to a systematic [screening for IgE reactions](#) to 4 panel foods. (can do 4 X 4 IgE food panels during a 1 year period under medicare and off course more albeit non – medicare). In addition the IgE tests would include SPECIFIC weeds, grasses, trees and pollens and fungi (including candida). This has not been done this thoroughly before in this client.

And as mentioned allergy type symptoms can also be produced by food sensitivities (not an immune based reaction) to substance such as salicylates, histamines and mono amines (Common in many foods and drinks that this client consumes). Failure to identify any food allergies would stimulate a search for these food sensitivities (through elimination diets).

Next enhancing **digestive efficacy** is crucial as undigested food in combination with any intestinal permeability would significantly expose an already hyper- inflammatory overwhelmed individual to greater allergen load. Also in many chronic disease conditions as in this case of bronchiectasis, the individual may be in a protein depletion state (as in this client) and as such get caught in a viscous cycle of impaired gastric acid production and diminished pancreatic digestive enzymes that then further leads to poor protein assimilation. The excessive mucus production seen in this client must also contribute to protein loss. Low protein status also reduces activity of microsomal oxidase enzymes that are responsible for neutralising many environmental chemicals. The corticosteroids are known to cause gastrointestinal disturbances and as such may negatively impact on digestive efficacy.

Next Essential **Fatty acid balance and metabolism** needs to be addressed as increased consumption of saturated fats and trans fats and increased intake of $\Omega 6$ foods (vegetable oils, nuts and seeds) at the expense of $\Omega 3$ fatty acids containing foods (fish oil, flaxseed oil, chia seeds or hemp seeds) will increase propensity of inflammation as eicosenoid production shifts to pro-inflammatory mediators and up regulation of pro-inflammatory genes.

Next **antioxidant status** must be optimised as “ high dose therapy with Vit C, tocopherols and flavanoids reportedly reduces hyperactive inflammatory processes by down regulating polymorphonuclear free radical release, mast cell histamine release and immune cell cytokine production”

Next enhance **hepatic detoxification** as environmentally sensitive individuals may become more hypersensitive to chemicals and food particles and immune complexes and in this case concurrent drug molecules (corticosteroids) due to these individuals having possible impaired and overwhelmed hepatic detoxification mechanisms leading to excess free radical production with subsequent glutathione depletion. On the other hand **inhalation of glutathione** can reduce respiratory inflammation.

Next correcting any **bowel dysbiosis** is essential and in this client even though the physical and MSQ relieved minimal abdominal discomfort and symptoms, research into the effects of the drugs being taken by this client show that gastro intestinal disturbance is a side effect with overgrowth of candida also indicated. Also Bronchiectasis has been linked to irritable/inflammatory bowel disease. In addition antibiotic therapy, particularly on the scale seen in this client, can SIGNIFICANTLY cause the overgrowth of toxigenic bowel flora, particularly (again) candida. Any resulting dysbiosis can contribute to immune hyperactivity via undue antigen uptake by enteric macrophages, thus activating T cell activity and increasing cytokine production. To correct dysbiosis will need to investigate bacteria growth in GIT. Use the Metamatrix GI effects DNA stool analysis and treat accordingly.

And finally **Specific disease therapeutics** should look at further enhancing immune system function and equilibrium, as continual escalation of infection is detrimental to the bronchiectasis and in a vicious loop the prevalent hyper inflammation seen in bronchiectasis promotes pathogen build up and stasis.

7. Liver/Cellular detoxification

And from assignment 4 we have the following and NOTE that some of these dietary recommendations are only relevant once food allergies and sensitivities have been established.

The status of the liver and other organ cells capacity for detoxification can be partly **tested with LFT's from ARL and/or a caffeine challenge test**. Glutathione status (see 4 above) is a key determinate factor in efficient cellular detoxification. **We may also expect some residual Mercury toxicity to be present in this client – check urine and plasma levels.**

Detoxification is an aware multi-system complex of enzymes, receptors, gene induction mechanisms and protein helpers and cofactors that runs continuously albeit with circadian influences. Detoxification removes from the body toxins from endogenous origins (hormones and their metabolites and other degradation products of normal cellular metabolism) and exogenous sources like drugs, environmental toxins, food and bacteria/microbes. A toxin in this case may be defined as a chemical compound/molecule/atom whose presence in the body tissues creates “stress” and although small short amounts of stress are known to be of benefit (can increase or “prime” cellular anti-oxidant status by up-regulating genes that code

for the rate limiting enzymes of glutathione synthesis - Gamma-glutamylcysteine synthetase), prolonged or chronic stress can eventually lead to whole organism disease expression. Stress in this case is the pull or push of metabolic pathways in directions that decrease cellular viability, functionality and reproduction and apoptosis mechanisms. The multi-enzyme complex commonly referred to as Phase I and Phase II detoxification systems has individual genetic variability with more and more SNP's being identified regularly and hence mechanisms to process toxins can vary between individuals. As many of these detox enzymes are inducible by cellular metabolites, which include environmental toxins (dioxins etc) and as the diet can be a rich source of some inducing (or suppressing) molecules – i.e phyto-nutrients – adequate intake and knowledge of how these nutrients/toxins influence detoxification is important.

Recent experimental findings highlight not only the importance of genetic polymorphic differences in both the CYP450 enzymes of Phase 1 and the conjugation enzymes of Phase II, but also the inter-individual differences in phytochemical (from food) metabolism and disposition. [1] [2] [3]. For clients showing elevated risk factors for CVD and early signs of atherosclerosis, of particular interest is the work of Cornelis et al, who demonstrated that ONLY one genotype of the glutathione S-transferases (GST) polymorphic genes – found in many tissues including heart and blood vessels – has the capacity to favorably effect the cardio-vascular system in relation to cruciferous vegetables intake and their effect on CVD. Only the genotype possessing the functional allele GSTT*1 has the capacity to be induced by glucosinolates (isothiocyanates in this case) from cruciferous vegetables. (eg. Cabbage, kale, broccoli, brussell sprouts, bean sprouts, collard greens etc.). The induction of the glutathione S-transferases enzymes by these NON toxic food metabolites leads to greater clearance of TOXIC metabolites by the same enzymes. Some of these toxic metabolites if not removed from the body could damage epithelial cells of blood vessels through various mechanisms that have been proposed and studied [2] Hence Know your DNA (through more advancements in laboratory genetic testing) and if possible, adjust accordingly.

Another example of a Phase II biotransformation enzyme is *Uridine 5_-diphospho-glucuronosyltransferase*

(*UGT*), that also metabolizes endogenous and exogenous compounds (some of which have been associated with cancer risk). Many phytochemicals have been shown to induce UGTs in humans. “These phytochemicals regulate transcription factors such as the nuclear factor-erythroid 2-related factor 2(Nrf2), aryl hydrocarbon, and pregnane X receptors as well as proteins in several signal transduction cascades that converge on Nrf2 to stimulate UGT expression. This induction can be modified by several factors, including phytochemical dose and bioavailability and interindividual variation in enzyme expression.” [4]

Environmental xenobiotics like dioxin (or the polychlorinated dibenzodioxins) are detoxified and eliminated in the body by upregulating the expression of Phase 1 Cytochrome P450

enzymes, in addition to certain Phase II enzymes and some transforming growth factors. This processes is facilitated by the aryl hydrocarbon receptor (AHR) in the cytosol of many cells. This AHR binds xenobiotics like polycyclic aromatic hydrocarbons and dioxins and upon binding undergoes a conformational change that then allows the receptor to migrate into the nucleus where it undergoes further changes and bindings that allow it (called the aryl hydrocarbon receptor complex at this stage - AHRC) to affect transcription of DNA sequences. [5] More detailed account of all currently known ligands for AHR, including dietary compounds like indole 3 carbinol and natural flavanoids and other exogenous and endogenous sources and their and others active metabolites, is also recently available. [9] The CYP450 gene upregulated by dioxin in many organs and tissues is CYP1A1 and to a lesser extent CYP1B1. However once these Phase 1 enzymes are activated, and in the course of detoxifying their specific substrates, (by bio-transforming the usually lipophilic substrate with the CYP450 enzyme in a reaction that uses oxygen and NADH as a substrate to produce a more water soluble compound), sometimes a MORE toxic intermediate is formed. (along with damaging reactive oxygen species or free radicals). These intermediates are mostly but sometimes not completely (in which case causing possible tissue damage and carcinogenesis) further transformed to inert substances and excreted by the Phase II conjugation enzymes. As mentioned previously the role of the glutathione and its associated enzymes is crucial at this stage, with glutathione acting both as an antioxidant and a substrate for Phase II conjugation reactions. Glycine , one of the three amino acids in glutathione (Glutamate and cysteine the other two), is also involved in Phase II glycation/conjugation reactions. In general Phase II conjugation enzymes include

- epoxide hydrolase found in microsomes / cytosol and works on epoxides
- sulphotransferase found in the cytosol using phospho adenosine 5 phosphosulphate and works on phenols, thiols and amines
- N- and O- methyl transferases found in the cytosol/microsomes using the methyl group from SAmE – adenosylmethionine - and works with phenols and amines
- N-acetyl transferases in the cytosol using acetyl CoA and works on amines
- Amino acid transferases in the microsomes and use acetyl CoA , taurine and glycine and work on carboxylic acids
- Glutathione transferases in microsomes and uses glutathione while working on electrophiles (these can be attacked by DNA/RNA causing self damage)
- Glucuronyl transferases in microsomes using uridine 3,5 diphosphoglucuronic acid and working on phenols,thiols, amines ans carboxylic acids [6]

As mentioned above, cysteine has been shown to be the rate limiting amino acid, (enzyme = Gamma-glutamylcysteine synthetase) in glutathione synthesis and because glutamate is so prevalent in foods, glycine is the other important amino acid. Foods that are **highest** in cysteine/methionine and glycine are listed below with mg content per **100gr food**

Methionine/Cysteine

brazil nuts ~ 1000mg

Chicken, Mutton and beef ~ 920mg

Sesame seeds, turkey, halibut fish, rabbit and watermelon seeds ~ 820mg

Swiss cheese, red salmon, lamb, pumpkin seeds ~ 730mg

Duck egg, tofu and tahini ~ 600mg

Egg raw ~ 600mg

Glycine

Chicken and turkey skin only ~ 3000mg

pumpkin seeds, beef, dried tofu ~ 2000mg

chicken and turkey with skin, almonds, sunflower seeds, flaxseed, tahini and amaranth ~ 1300mg

halibut fish and red salmon, broad fava beans and split peas ~ 900mg

Swiss cheese, ~ 500mg

Egg raw ~ 430mg

Ref [7]

Most of what we know about the detoxification activities of Phase 1 CYP450 enzyme complexes comes from the pharmaceutical industry because nearly all drugs are metabolised via these complexes. As mentioned the Phase 1 human detoxification cytochrome P450 enzymes can be both induced and inhibited. A timely (2008) and extensive review of ALL known CYP450 enzymes and their substrates (drugs, xenobiotics and a few herbs and less foods) details and lists these interactions [8]

More work is being done and needs to be done in the field of synergistic combination of nutrients that induce or inhibit detoxification pathways. While some of the CYP450 enzymes are expressed constitutively, the expression of others can be modified by phytochemicals (CYP1A1) like complexes of green tea extracts that have both antagonistic and agonistic activity on AHR, while specifically, epigallocatechin gallate (EGCG) (a type of catechin and is the most abundant catechin in tea) acts as a strict AHR antagonist. As substances like dioxins can upregulate CYP1A1 via the AHR and thus instigate increases in secondary more toxic metabolites, the synergistic effects of phytochemicals on modulating CYP1A1 expression can be beneficial for whole organism health. Much more needs to be learnt from these synergistic phyto-nutrient actions as previous studies have shown reduced incidences of cancers and other diseases as a result of phytonutrient intake. [10] A great review focuses on some of these synergies. [10]

As part of the detoxification process, the elimination from the body of the conjugated compounds can proceed via, sweat, breath, mucus, hair, urine and feces. An enzyme that modulates glucuronidation is beta-glucuronidase and it does this through its capacity to **de**-glucuronidate or de-conjugate via hydrolysis. Glucuronidase is present in most tissues, particularly liver, kidney, spleen, intestinal epithelium, and endocrine and reproductive organs. "Thus, circulating glucuronyl conjugates of steroid hormones

and other ligands, in the past generally considered inactive and destined for excretion, are now recognized as still having the potential to interact with target tissues. Glucuronidase is thought to play an important role in regulating glucuronidation of xenobiotics and endogenous compounds” [11] Inter-individual variation in glucuronidase activity in human liver has been attributed to different levels of enzyme expression. As glucuronidase activity is present in the gut, the potential exists for certain conjugated compounds excreted in bile after glucuronidation to be de-conjugated in the gut and reabsorbed, leading to increased risk of carcinogenesis and other diseases. Data suggest that certain foods have the potential to alter glucuronidase activity.

“The dietary constituent D-glucaric acid is a precursor of the potent glucuronidase inhibitor, D-glucaro-1,4-lactone. It is found in substantial amounts in plant foods, including a wide variety of fruits and vegetables. The D-glucaric acid content of commonly consumed plant foods ranges from 10 mg/100 g in lettuce and grapes to 350 mg/100 g in **bean sprouts, cruciferous vegetables, apples and grapefruit**. Oranges, apricots, cherries, and tomatoes also are significant sources of D-glucaric acid” [11] In mammals, glucaric acid is also an endogenous metabolite of glucuronic acid - thus the contribution of exogenous sources to glucaric acid exposure remains to be established. The paper by Lampe et al found that intake certain plant foods inversely affected beta-glucuronidase activity – presumably in the gut – thus decreasing the possibility of re absorption of toxins.

“In conclusion, serum glucuronidase activity was inversely associated with specific nutrients that characterize the intake of a more plant-based diet, namely, greater intakes of plant protein and dietary fiber. Similarly, glucuronidase was inversely associated with biomarkers of V&F intake, including serum concentrations of and carotene, and cryptoxanthin. Furthermore, several botanical groupings of V&F, e.g., Cucurbitaceae, Rosaceae and Leguminosae, were inversely associated with serum glucuronidase activity and may thus be particularly good sources of D glucaric acid or other glucuronidase inhibitors. In our effort to understand the effect of endogenous glucuronidase activity on carcinogenesis and modulation of risk factors for cancer, the capacity of a high plant food diet in humans warrants further investigation” [11]

Finally as many people have exposure to some sort of heavy metal like arsenic, lead and mercury, detoxification and elimination of these toxins needs to be understood. While dentists are still denying that mercury is harmful and continue to put it in the mouths of 7 year old children, many people have amalgam/mercury residues constantly leaching mercury into the body. The effects of mercury in many of the body tissues and cellular compartments and subsequent detoxification is complex.[12] A very recent 2009 article focuses on heavy metal – glutathione interactions. [13] Some people are able to handle heavy metal exposure/toxicity better than others and this has led to much controversy around the issues of “safe “ mercury doses. Ortiz [14] shows and demonstrates through classic genetic experiments the important missing link – namely that individual phenotypic sensitivity to heavy metal exposure with

subsequent toxic and carcinogenic effects, is directly related to the genotype of that individual for glutathione synthetase - GS (GS is the enzyme in the final stage of glutathione synthesis). ie reduced expression of GS = greater sensitivity to heavy metal exposure. This also shows that glutathione synthetase expression is important in detoxification capacity (not just the rate limiting enzyme in the first part of glutathione synthesis – namely Gamma-glutamylcysteine synthetase).

And lastly as many people drink alcohol and detoxification of ethanol and its metabolites is important in humans, this paper [18] looks at induction of the CYP2E1 enzymes (and ADH – alcohol dehydrogenase) by ethanol and subsequent possibilities and mechanisms of oxidative stress and neuronal injury.[18]

Other recent interesting and informative papers and reviews on detoxification in humans are [15], [16] and [17] below.

[1] *Role of Ploymorphic human cytochrome P450 enzymes in esteron oxidation, Alistair E Cribb, et al, Cancer Epidemoil Biomarkers Prev, 2006;15(3)*

[2] *GSTT1 genotype modifies the association between cruciferous vegetable intake and the risk of myocardial infarction, Cornelis et al, Am J Clin Nutr, 2007 ; 86:752*

[3] *Interindividual differences in phytochemical metabolism and disposition, J W Lampe and Jyh- Lurn Chang, Semin Cancer Biol, 2007; 17(5)*

[4] *Phytochemical Regulation of UDP-Glucuronosyltransferases: Implications for Cancer Prevention, Misty R. Saracino and JohannaW. Lampe, NUTRITION AND CANCER, 59(2), 121–141, 2007*

[5] *Roles of Coactivator Proteins in Dioxin Induction of CYP1A1 and CYP1B1 in Human Breast Cancer Cells, Robert T. Taylor,1 Feng Wang,† Erin L. Hsu, and Oliver Hankinson, TOXICOLOGICAL SCIENCES 107(1), 1–8 (2009)*

[6] *The detoxification enzyme systems, DeAnn J Liska, Alternative Medicine Review, Vol3 , 1998*

[7] <http://www.nutritiondata.com/>

[8] *Inhibition and nduction of human cytochrome P450 enzymes: current status, Pelkonen et al, Arch Toxicol, 208, 82;667*

[9] *The search for endogenous activators of the Aryl Hydrocarbon Receptor, Lihn P nguyen and C A Bradfield, Chem Res Toxicol, 2008 21(1) 102*

[10] *Mechanisms of combined action of different chemopreventive dietary compounds: a review, Theo M de Kok et al, Department of health risk analysis and toxicology, university of Maastricht, the Nehterlands. From google scholar search*

[11] *Serum beta-glucuronidase activity is inversely associated with plant food intakes in Humans, Lampe et al, 2002, J Nutr, 1341*

[12] *Molecular and ionic mimicry and the transport of toxic metals, Christy C bridges and Rudolf K Zalups, Toxicol Appl Parmacol, 2005 204(3)*

[13] *Unraveling arsenic – glutathione connections, David J Thomas, Toxicological Sciences, 107(2), 2009*

[14] *Investigating arsenic susceptibility from a genetic perspective in drosophila reveals a key role for glutathione synthetase, Muniz Ortiz et al, Toxicological Sciences, 2009*

[15] *Detoxification reactions: relevance to ageing*, Piotr Zimniak, *Ageing Research Reviews*, 2008, 281-

[16] *Diet and detoxification enzymes*, Elizabeth H Jeffery, *Alternative therapies in health and medicine*, 2007, 13, p98

[17] *Managing biotransformation: introduction and overview*, *Alternative therapies in health and medicine*, 2007, 13, p85

[18] *Mechanism of alcohol induced oxidative stress and neuronal injury*, Haorah et al, *Free Radic Biol Med*, 2008, 45(11)

8. Hormone synthesis and balance and 9. Neurotransmitter synthesis and balance

As we work through improving gut protection and function and balancing gut flora and eliminating food sensitivities and allergies and balancing the diet, we may find that these body messengers stabilize automatically. Also we are treating neuro-transmitters with specific nutrients mentioned above and from previously we saw that:-

Neurotransmitters are involved in the arousal/sleep system and these molecules and their receptors when imbalanced also contribute to the following - anxiety and hyperactivity, insomnia, ringing in ears, carbohydrate craving, stress and mental exhaustion, general fatigue and exhaustion, highly reactive to stress, emotional instability, increased sensitivity to pain, irritability and difficulty getting to sleep due to overactive mind.

Very briefly neurotransmitters (NT) are usually either inhibitory or excitatory however different NT act in different areas of the brain and the same NT can be excitatory in one area while inhibitory in another. Also whether the result is excitatory or inhibitory more so depends on the receptor that detects the NT and the area of the brain it is in.

NT are either mostly amino acids or derived from amino acids with exceptions being acetylcholine, nitric oxide, adenosine amongst others. Many vitamin and mineral cofactors are needed for NT synthesis and as such place a strong demand on adequate dietary intake and during times of stress and disease, inflammation and medication, these dietary requirements can increase significantly. Some amino acids can be synthesised from other precursors in the body while others like tryptophan are ONLY obtained from food. Of course all amino acids in the diet come from adequate **protein** intake, digestion and absorption.

Some of these NT are summarised below with their required nutrient cofactors and associated symptoms of the NT imbalance/deficiency

Glutamate – excitatory – made from glutamine/alphaKetoGlutarate and also requires leucine for optimal formation and used as precursor for GABA

GABA (Gamma aminobutyric acid) – inhibitory – important in sleep, **Vit B6 and B3** required and deficiency signs include anxiety, alcohol craving, insomnia, panic attacks, trembling, palpitations, cool or clammy hands, ringing in ears, lump in throat, seizures, carbohydrate craving, PMS.

Dopamine important for movement, pleasure/pain feelings and emotional response, precursors are **Tyrosine (or phenylalanine), Vit B6, magnesium, zinc, iron**, and these

nutrient may also effect production - folic acid (as used in tetrahydrobiopterin) along with Vit C, B3, B12 and copper. Deficiencies implicated in restless leg syndrome and periodic leg movements in sleep.

Acetylcholine mostly excitatory , parasympathetic nervous system control and muscle movement – important in REM sleep – nutrients needed are **choline, vit B5, Vit B1 and magnesium** with Vit C and acetyl carnitine seen to aid synthesis and synaptic release.

Deficiencies in acetylcholine show as manic episodes, **light sleep**, poor coordination, poor attention, poor concentration and focus, decreased short term memory, **fatigue**, dementia, confusion, **highly reactive to stress, increased heart rate and anxiety**.

Serotonin is inhibitory and regulates mood, sleep and eating behaviours. Serotonin facilitates sleep by decreasing sensory input and inhibition of the motor system. Nutrients and precursors – **tryptophan and Vit B6** are very important while low levels of Vit B3 negatively effect serotonin synthesis and the cofactors **magnesium, zinc and Vit C and folic acid**. Iron and calcium also important. Deficiency signs include – aggressiveness, bad temper, anxiety, performance anxiety, panic attacks, carbohydrate and alcohol cravings, depression (mild to moderate), eating disorders, emotional instability, increased sensitivity to pain, irritability, difficulty getting to sleep due to over active mind, seasonal affective disorder, low self esteem and poor dream recall.

Noradrenalin is stimulatory and overproduction can occur in times of high stress. It is made from dopamine (so all its contingent nutrients are also required) with the essential cofactors **Vit C and copper**.

Histamine is made from the amino acid histidine and requires Vit B6 and is important in wakefulness and arousal. Deficiency symptoms include free floating anxiety, over active mind, agitation, confusion, anxiety, memory loss, low libido, poor healing, nausea, suppressed appetite, and poor hearing.

Taurine is an inhibitory NT and plays a role in sleep, memory and concentration and antioxidant function in insulin function and taurine increases levels of the NT histamine and acetylcholine. Taurine is readily available from the diet in meats, fish and milk and deficiencies show as – anxiety, convulsions, depression, insomnia, poor memory, and insulin resistance.

The two amino acids **Glycine** (inhibitory)and **Aspartic acid** (excitatory) are also NT while **Orexins** are excitatory neuropeptide hormones essential for wakefulness and arousal and is very important as a mediator between metabolism and sleep regulation as orexin release is stimulated by grehlin(hunger hormone) and hypoglycaemia, implying that if you get hungry or hypoglycaemic while sleeping, the orexin releasing neurons will wake you up.

Adenosine is also an inhibitory NT with deficiency symptoms including – insomnia, anxiety, irritability and over active mind.

Endogenous opioids are implicated in the induction and maintenance of the sleep state and include enkephalins, endorphins and dynorphine. DL phenylalanine can increase opioids (by inhibiting enkephalinase) while serotonin (via tryptophan) stimulates opioid release and

cofactors needed are **Vit B3 and Vit B6, magnesium and zinc**. Deficiencies lead to addiction, pain, stress, depression, antisocial behaviour, memory loss, irritability, learning disorders, alcohol craving, headaches and aggressiveness.

As mentioned the **receptors** for the above NT play an even more important role in final NT effect and some of these receptors have specific nutrient requirements. For example the dopamine receptor requires a **follic acid** pathway methylation. The Vitamin B12 dependant enzyme methionine synthase is needed for the dopamine stimulated methylation of membrane phospholipids of the dopamine receptor. And 5 methyl THF is required for subsequent re-methylation. Another example is the Glutamate receptor which requires simultaneous presence of glutamate, glycine (or serine) and zinc.

And finally it should be emphasised that most neurotransmitters are derived from food or dietary factors and if diet is poor or lacking in amino acids and protein, essential fatty acids, and vitamin and mineral cofactors or demand is high as in illness, stress and inflammation, then synthesis and release of neurotransmitters will be compromised and the symptoms of deficiency seen above will manifest.

In correcting neurotransmitter balance through diet and nutritional supplementation it is important to observe the following

1/ make sure digestive function is adequate. (can supplement with betaine HCL) And if gut dysbiosis is present, may need to supplement with pre and pro biotics, essential fatty acids and fibre.

2/ If supplementing with amino acids follow this protocol –

[Tyrosine, phenylalanine and tryptophan should be given on an empty stomach with fruit juice or honey \(aids in neuronal uptake\). Do NOT give these after a meal.](#)

Separate each amino by 3 hrs as each competes with each other for membrane transport.

All neurotransmitter precursors above should be given concurrently with their cofactors to ensure optimum conversion rates.

Tryptophan and histadine should be given in the morning, tyrosine and phenylalanine should be given during the day with adenosine and melatonin at night.

Adenosine is recommended to be taken sublingually.

3/ Supplementing with **essential fatty acids and in particular DHA and phosphatidyl serine and inositol** ensure optimum membrane performance in the neuronal cell.

And

4/ making sure that neuronal mitochondrial function is optimal by supporting with – **lipoic acid, acetyl L carnitine, NAD, CoEnzyme Q10, magnesium and B complex vitamins**.

A more detailed discussion covering all above areas showing all nutrient and enzyme adjustments for this particular client is available upon request.

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It is a sample of the work carried out on a real client during a full Nutrition Medicine Health Assessment and Treatment. It is designed to highlight the attention to detail and individualised care given to each client during an assessment and Treatment. It is not intended to help in any form of self diagnoses or self treatment.

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